The white pixels represent beads bearing oligos (probes) to which complementary Cy3-labeled oligos are bound. Varying levels of intensity indicate that different numbers of Cy3-labeled oligos bound to different beads. (White pixels indicate a greater number of bound oligos.) The figure shows trapping of zero, one, or multiple beads at various locations. Bead clumping and trapping of multiple beads at the edges of the array can be reduced by using a field-circulator loop.

Example 4

Performing Genotyping Using a Random Array of Magnetic Beads

[0214] A genotyping assay is performed in a fashion essentially identical to that described in Fan, J., et al., referenced above, except that rather than employing a substrate-bound oligonucleotide array, the magnetic bead array of the present invention is used. A pool of magnetic beads is encoded with unique complementary tags as described, and hybridization to the labeled sample is performed. Following off-chip hybridization, the magnetic beads are dispensed onto the magnetic chip as described above and detected using either confocal laser scanning or a charge coupled device. Such a reformatting approach allows use of a populations of beads that have been tagged in advance, and thus provides an efficient and flexible means of utilizing the random order array of magnetic beads for genotyping and other applications.

We claim:

1. A device for forming an array of magnetic particles, the device comprising:

a substrate comprising a plurality of magnetic regions, wherein the magnetic regions produce a plurality of localized magnetic fields when magnetized, and wherein the localized magnetic fields are sufficient to trap a magnetic particle with a trapping energy at least five times greater than the thermal energy of the particle at room temperature.

2. The device of claim **0**, wherein the localized magnetic fields are sufficient to trap a magnetic particle with a trapping energy at least an order of magnitude greater than the thermal energy of the particle at room temperature.

3. The device of claim **0**, wherein the localized magnetic fields are sufficient to trap a magnetic particle with a trapping energy at least three times greater than the thermal energy of the particle at room temperature.

4. The device of any of claims **0**, **2**, or **3**, wherein the thermal energy of the particle is approximately 0.025 eV.

5. The device of any of claims **0**, **2**, or **3**, wherein the localized magnetic fields exist substantially in a volume between adjacent magnetic regions.

6. The device of any of claims **0**, **2**, or **3**, wherein each of the localized magnetic fields corresponds to a different single magnetic region and exists substantially in a volume between opposite poles of that magnetic region.

7. The device of any of claims **0** to 4, wherein the magnetic regions project above the surface of the substrate.

8. The device of claim 7 wherein the magnetic regions have walls that are substantially perpendicular to the substrate.

9. The device of claim 7, wherein the magnetic regions comprise a layer of magnetic material and a layer of nonmagnetic material, wherein the layer of nonmagnetic material is located between the substrate and the layer of magnetic material.

10. The device of claim **0**, wherein the magnetic material regions are arranged in a pattern of mutually perpendicular rows and columns.

11. The device of claim **0**, wherein the magnetic regions are arranged in an array of subarrays configuration.

12. The device of claim **0**, wherein the magnetic regions are substantially uniform in shape.

13. The device of claim **0**, wherein the magnetic regions are substantially rectangular in shape.

14. The device of claim **0**, wherein the magnetic regions have a circular cross-section.

15. The device of claim **0**, wherein the magnetic regions are substantially uniform in size.

16. The device of claim **0**, wherein the number of magnetic regions is at least 1000 per centimeter squared.

17. The device of claim **0**, wherein the number of magnetic regions is at least 10,000 per centimeter squared.

18. The device of claim **0**, wherein the number of magnetic regions is at least 100,000 per centimeter squared.

19. The device of claim **0**, wherein the number of magnetic regions is at least 250,000 per centimeter squared.

20. The device of claim **0**, wherein the number of magnetic regions is at least 1,000,000 per centimeter squared.

21. The device of claim **0**, wherein adjacent magnetic regions are separated by a gap approximately equal in size to the size of a magnetic particle.

22. The device of claim 21, wherein the magnetic particle has a greatest dimension selected from the group consisting of: 30 nm, 100 nm, 300 nm, 500 nm, 1 μm, 3 μm, 5 μm, and 10 μm.

23. The device of claim 22 wherein the magnetic particle is substantially spherical, and the greatest dimension of the particle is the diameter of the particle.

24. The device of claim **0**, wherein adjacent magnetic regions are separated by a gap having a greatest dimension approximately equal in size to the greatest dimension of a magnetic particle.

25. The device of claim 24, wherein the gap has a greatest dimension approximately equal in size to the greatest dimension of a magnetic particle having a greatest dimension selected from the group consisting of: 30 nm, 100 nm, 300 nm, 500 nm, 1 μm, 3 μm, 5 μm, and 10 μm.

26. The device of claim 25, wherein the magnetic particle is substantially spherical, and the greatest dimension of the particle is the diameter of the particle.

27. The device of claim 21, wherein the gap has a minimum length of approximately 1 micron.

28. The device of claim 21, wherein the gap has a minimum length of approximately 3 microns.

29. The device of claim 21, wherein the gap has a minimum length of approximately 5 microns.

30. The device of claim **0**, wherein the magnetic regions comprise a magnetic material.

31. The device of claim 30, wherein the magnetic material is a ferromagnetic material.

32. The device of claim **0**, wherein the substrate comprises a nonmagnetic material

33. The device of claim **0**, wherein at least a portion of the device comprises a biocompatible material.